TECHNICAL NOTE

NASA CR-
141603

Feasibility of Converting Hi-Speed Processor For Processing Kodak Film Types 7381/7271 (16mm) and 5381/5271 (35mm) Using Kodak ECP Chemistry

Prepared Under

Contract NAS 9-11500
Task Order HT-109

Prepared By

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Photoscientist

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PHOTOGRAPHIC TECHNOLOGY DIVISION
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
LYNDON B. JOHNSON SPACE CENTER
HOUSTON, TEXAS

Technicolor Graphic Services, Inc

FEASIBILITY OF CONVERTING HI-SPEED PROCESSOR FOR PROCESSING KODAK FILM TYPES 7381/7271 (16mm) and 5381/5271 (35mm) Using Kodak ECP CHEMISTRY

This report has been reviewed and is approved.

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SECTION I

INTRODUCTION

This report describes testing conducted to determine the feasibility of converting the 16/35/70 Hi-Speed Processor to process Kodak film types 7381/7271 (16mm) and 5381/5271 (35mm) color negative films using Kodak ECP chemistry.

SECTION II

TEST PROCEDURES

1. Dump ME-2A chemistry and thoroughly clean tanks. Fill tanks with ECP chemistry. (See Figure 1)

2. Plumb Tanks 5 and 6 together to provide for two wash tanks.

3. Modify existing 16 and 35mm scrubbers to be used for the removal of the Rem-Jet backing.

4. Prepare 16 and 35mm test loops containing sensitometry and representative imagery.

5. Prepare sensitometric test strips for each film type.

6. Determine approximate machine speed for proper time in color developer for the 75°F process.

7. Process sensitometric strips.

8. Prepare acceptable internegative and then a print using 16mm and 35mm printer loops.

HI-SPEED PROCESSOR CONFIGURATION

Tank Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
ME-2A PROCESS	Spray Rinse	1st Developer	Wash	Hardener	Acid Rinse	Wash	Color Developer	Wash	Hardener	Acid Rinse	Wash	Bleach	Fix	Spray Wash	Stabilizer
ECP PROCESS*	Spray Rinse	Color Developer	Wash	Fix	Wash	Wash	Bleach	Wash	Fix	Skip	Skip	Wash	Wash	Spray Wash	Stabilizer

* Auxilliary tank used for prebath to facilitate Rem-jet backing removal.

Figure 1

SECTION III

DISCUSSION

During the first week in May, the Hi-Speed processor was thoroughly cleaned and filled with the ECP chemicals. For the initial testing, no hypo clearing agent was used and no attempt was made to establish replenishment systems for the process.

Without making any modifications to the machine, the time in each critical solution was close to that recommended by Kodak except for the wash after the color developer (Table 1). The longer than recommended wash does not appear to be a problem since the lab has been successful in producing good quality 16mm internegatives and release prints. Typical 16mm sensitometric curves are shown in Figures 2 through 5.

The color internegative material is considerably slower than the reversal duplicating stocks commonly used by the Motion Picture Laboratory. At first, it was thought there might be a problem in getting enough light from the Bell and Howell printer to properly expose the internegative film. This was solved by increasing the voltage to the lamp from 80 to 110 volts.

All tests were accomplished first with the 16mm films. Sensitometric strips and test imagery have been processed satisfactorily on an almost daily basis since the beginning of May. In addition, some actual production jobs have been accomplished with excellent results. The 35mm films were tested later in the program. The only major problem encountered was a blue-green crossover at a density of about 2.00 with the 35mm internegative film 5271. Typical D-log E curves are shown in Figures 6 through 9. To determine if this was due to an emulsion difference or a process change, 16mm sensitometric strips

TABLE 1

PROCESS STEP	KODAK RECOMMENDED TIME 75°F	TIME IN SOLUTION 16mm - 41 fpm	TIME IN SOLUTION 35mm - 5 fpm
Prebath	10-20 sec.	10 sec.	10 sec.
Spray Rinse	10-20 sec.	1 min. 52 sec	1 min. 5 sec.
Color Developer	8 min.	7 min. 44 sec	7 min. 2 sec.
Spray Rinse	10-20 sec.	1 min. 6 sec.	1 min. 46 sec.
First Fixing Bath	2 min.	1 min. 52 sec.	1 min. 46 sec.
Wash	1 min.	3 min. 44 sec.	3 min. 32 sec.
Bleach	6 min.	6 min. 32 sec.	5 min. 56 sec.
Wash	2 min.	1 min. 52 sec.	1 min. 46 sec.
Second Fixing Bath	2 min.	1 min. 52 sec.	1 min. 46 sec.
Wash	6 min.	3 min. 44 sec.	3 min. 32 sec.
Stabilizing Bath	10 sec.	1 min. 52 sec.	1 min. 46 sec.

DATE 5-30-74 CONTROL # 10·45 TASK _____ PREPARED BY _____

FILM 7271 EMULSION # 165-112 MFG _____ EXPIRATION DATE _____

EXPOSURE DATA		PROCESSING DATA		DENSITOMETRY	
SENSITOMETER	I-B	PROCESSOR	Hi-Speed	INSTRUMENT	MacBeth
ILLUMINANT	2850 °K	CHEMISTRY	ECP	TYPE	TD504
TIME	2 SEC.	SPEED	TANKS 41 FPM	APERTURE SIZE	3 MM
FILTER	2B	TEMP °F	75 TIME	FILTER	Visual
				SPEED ( )	
				D-MAX	
				GAMMA	
				BASE + FOG	

CHEMICAL ANALYSIS

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Figure 2

Technicolor

ABSOLUTE LOG E AT R.L.E. = 0

-10

mcs ergs/cm²

DATE 5-30-74 CONTROL # 10:45 TASK _____ PREPARED BY _____

FILM 7271 EMULSION # 165-112 MFG _____ EXPIRATION DATE _____

EXPOSURE DATA	PROCESSING DATA	DENSITOMETRY	
SENSITOMETER I-B	PROCESSOR Hi-Speed	INSTRUMENT MacBeth	SPEED ( )
ILLUMINANT 2850 °K	CHEMISTRY ECP	TYPE TD504	D-MAX
TIME 2 SEC.	SPEED TANKS 41 FPM	APERTURE SIZE 3 MM	GAMMA
FILTER 2B	TEMP °F 75 TIME	FILTER Status M	BASE + FOG

CHEMICAL ANALYSIS

SP GR

pH

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Figure 3

green

blue

red

Technicolor

+R *G •B

ABSOLUTE LOG E AT R.L.E. = 0

-10

mcs ergs/cm²

DATE 5-30-74 CONTROL # 10:45 TASK _____ PREPARED BY _____

FILM 7381 EMULSION # 378-141 MFG _____ EXPIRATION DATE _____

EXPOSURE DATA	PROCESSING DATA	DENSITOMETRY
SENSITOMETER I-B	PROCESSOR Hi-Speed	INSTRUMENT MacBeth / SPEED ( )
ILLUMINANT 2850 °K	CHEMISTRY ECP	TYPE TD504 / D-MAX
TIME 5 SEC.	SPEED TANKS 41 FPM	APERTURE SIZE 3 MM / GAMMA
FILTER 2B+2043+Orange Mas	TEMP °F 75 TIME	FILTER Visual / BASE + FOG

CHEMICAL ANALYSIS

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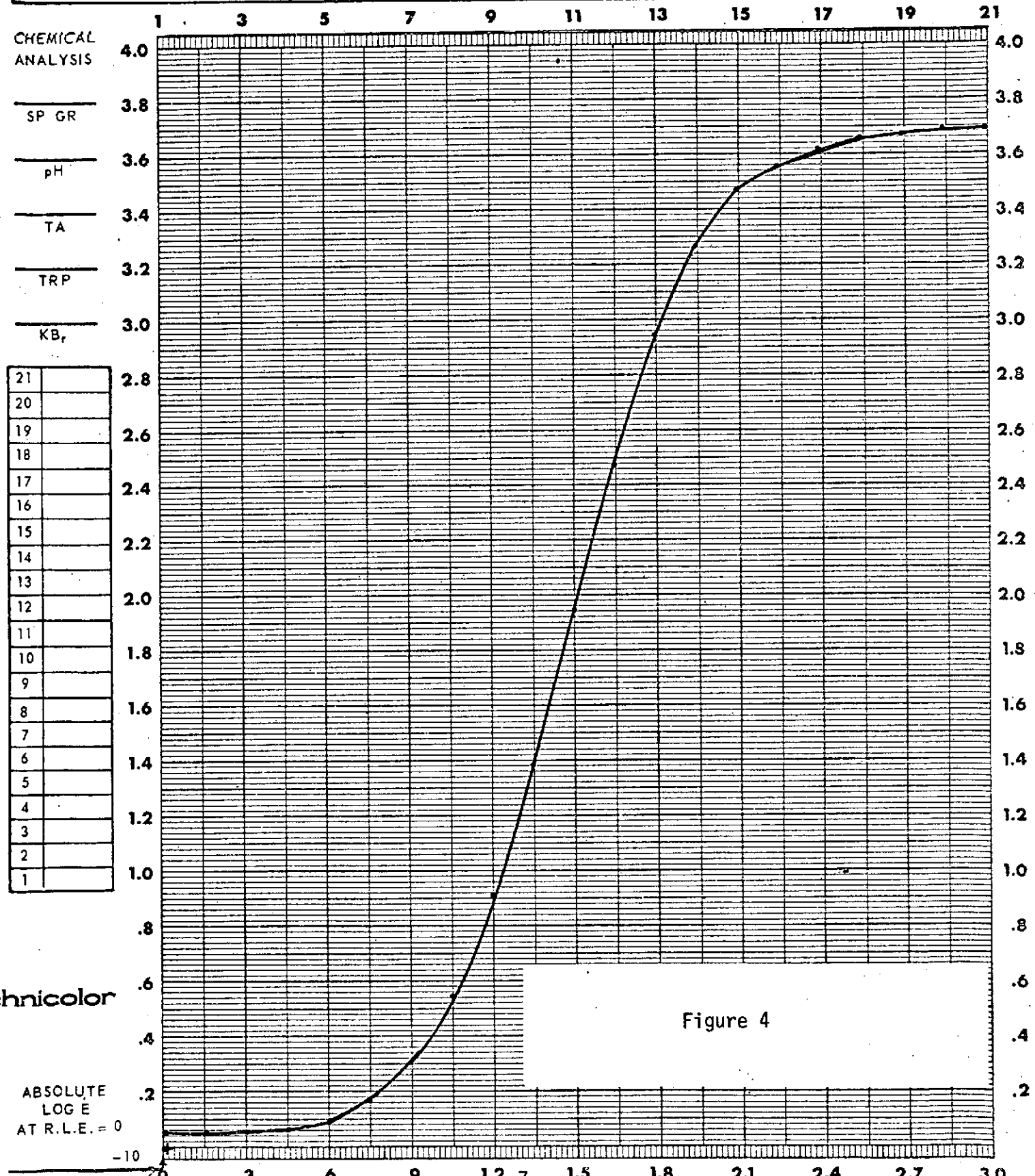

Technicolor

Figure 4

DATE 5-30-74 CONTROL # 10:45 TASK _____ PREPARED BY _____

FILM 7381 EMULSION # 378-141 MFG _____ EXPIRATION DATE _____

EXPOSURE DATA		PROCESSING DATA		DENSITOMETRY	
SENSITOMETER	I-B	PROCESSOR	Hi-Speed	INSTRUMENT	MacBeth
ILLUMINANT	2850 °K	CHEMISTRY	ECP	TYPE	TD504
TIME	5 SEC.	SPEED ____ TANKS	41 FPM	APERTURE SIZE	3 MM
FILTER	2B+2043+Orange Mask	TEMP °F	75 TIME	FILTER	Status A
				SPEED ( )	
				D-MAX	
				GAMMA	
				BASE + FOG	

CHEMICAL ANALYSIS

SP GR

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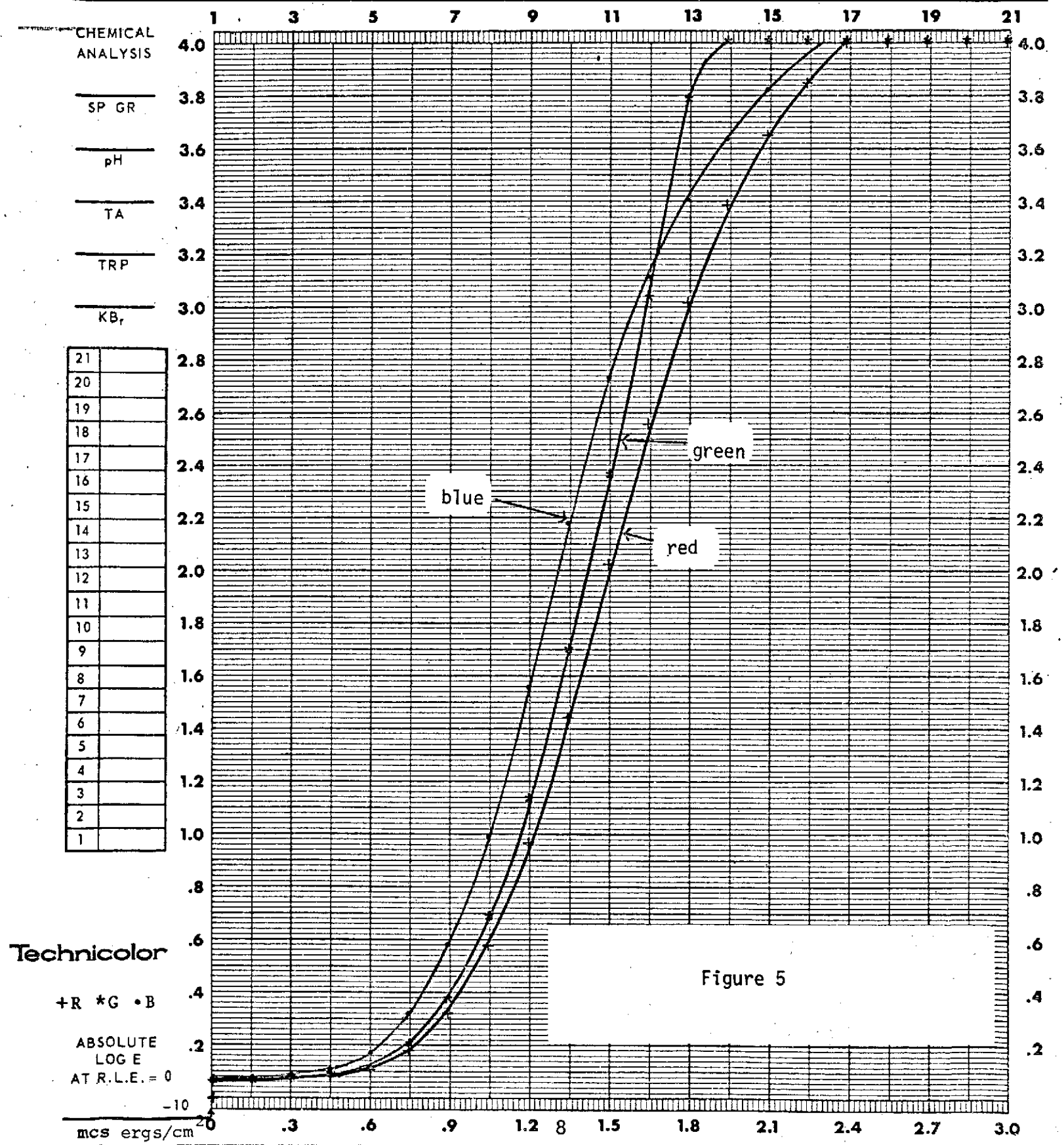

Technicolor

+R *G •B

ABSOLUTE LOG E AT R.L.E. = 0

-10 -20

mcs ergs/cm

.3 .6 .9 1.2 1.5 1.8 2.1 2.4 2.7 3.0

Figure 5

DATE 7-3-74 CONTROL # 1300 TASK _____ PREPARED BY _____

FILM 5271 EMULSION # 152-212 MFG _____ EXPIRATION DATE _____

EXPOSURE DATA	PROCESSING DATA	DENSITOMETRY	
SENSITOMETER I-B	PROCESSOR Hi-Speed	INSTRUMENT MacBeth	SPEED ( )
ILLUMINANT 2850 °K	CHEMISTRY ECP	TYPE TD504	D-MAX
TIME 2 SEC.	SPEED TANKS 5 FPM	APERTURE SIZE 3 MM	GAMMA
FILTER 2B	TEMP °F 75 TIME	FILTER Visual	BASE + FOG

CHEMICAL ANALYSIS

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Figure 6

Technicolor

ABSOLUTE LOG E AT R.L.E. = 0

-10

mcs ergs/cm^2

DATE 7-3-74 CONTROL # 1300 TASK _____ PREPARED BY _____

FILM 5271 EMULSION # 152-212 MFG _____ EXPIRATION DATE _____

EXPOSURE DATA		PROCESSING DATA		DENSITOMETRY	
SENSITOMETER	I-B	PROCESSOR	Hi-Speed	INSTRUMENT	MacBeth
ILLUMINANT	2850 °K	CHEMISTRY	ECP	TYPE	TD504
TIME	2 SEC.	SPEED ____ TANKS	5 FPM	APERTURE SIZE	3 MM
FILTER	2B	TEMP °F	75 TIME ____	FILTER	Status M
				SPEED ( )	____
				D-MAX	____
				GAMMA	____
				BASE + FOG	____

CHEMICAL ANALYSIS

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Figure 7

Technicolor

+R *G •B

ABSOLUTE LOG E AT R.L.E. = 0

mcs ergs/cm^2

DATE 7-3-74 CONTROL # 1300 TASK _____ PREPARED BY _____

FILM 5381 EMULSION # 644-122 MFG _____ EXPIRATION DATE _____

EXPOSURE DATA	PROCESSING DATA	DENSITOMETRY	
SENSITOMETER I-B	PROCESSOR Hi-Speed	INSTRUMENT MacBeth	SPEED ( )
ILLUMINANT 2850 °K	CHEMISTRY ECP	TYPE TD504	D-MAX
TIME 5 SEC.	SPEED TANKS 5 FPM	APERTURE SIZE 3 MM	GAMMA
FILTER 2B+2043+Orange Mas	TEMP °F 75 TIME	FILTER Visual	BASE + FOG

CHEMICAL ANALYSIS

SP GR

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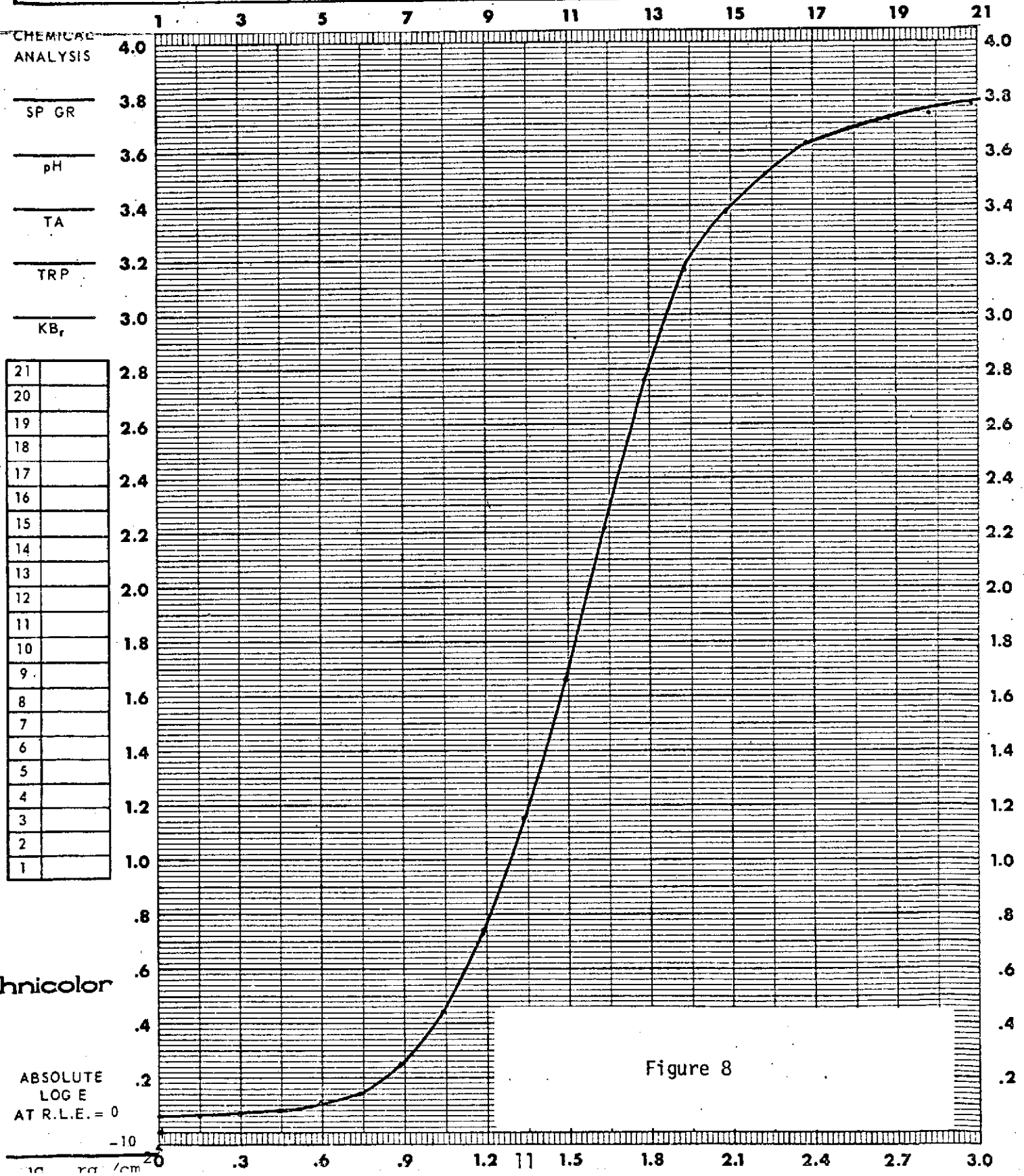

Figure 8

DATE 7-3-74 CONTROL # 1300 TASK _____ PREPARED BY _____

FILM 5381 EMULSION # 644-122 MFG _____ EXPIRATION DATE _____

EXPOSURE DATA	PROCESSING DATA	DENSITOMETRY
SENSITOMETER I-B	PROCESSOR Hi-Speed	INSTRUMENT MacBeth / SPEED ( )
ILLUMINANT 2850 °K	CHEMISTRY ECP	TYPE TD504 / D-MAX
TIME 5 SEC.	SPEED TANKS 5 FPM	APERTURE SIZE 3 MM / GAMMA
FILTER 2B+2043+Orange Mas	KTEMP °F 75 TIME	FILTER Status A / BASE + FOG

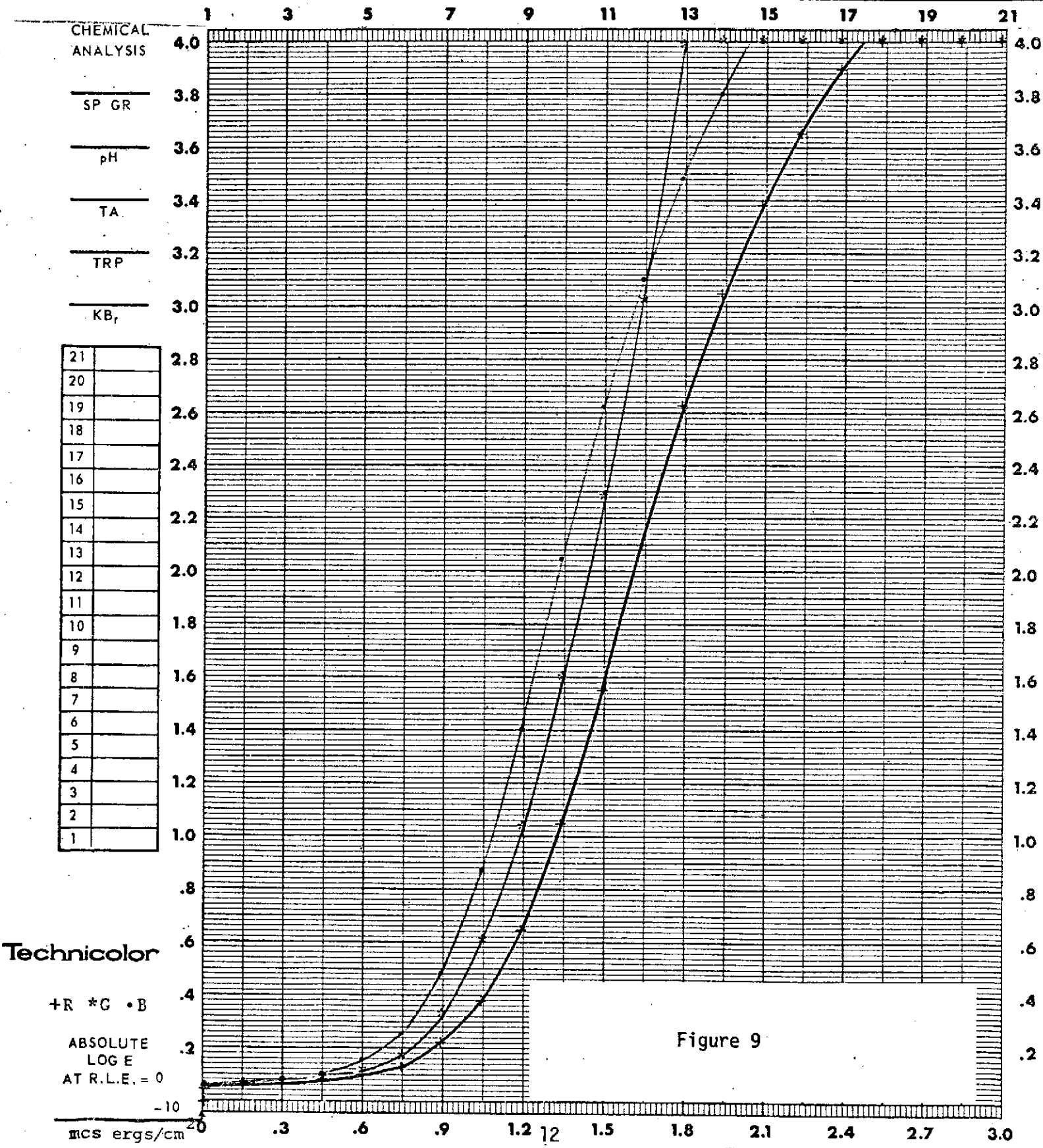

Figure 9

were processed "piggy-back" with 35mm sensitometry on the 35mm side of the machine. The 16mm film showed the same crossover effect as the 35mm indicating a process problem (Figures 10, 11). The most probable cause is a change in agitation since the 35mm film is processed at a speed of 5 feet per minute as opposed to the 41 feet per minute used for the 16mm film. There could also be an effect due to depletion of the chemicals caused by a lack of replenishment. Recent chemical analysis by the Process Control group indicates that the ECP solutions in the tanks should be dumped and replaced by fresh chemistry before conducting any more tests. However, even with the crossover, the laboratory has prepared internegatives suitable for use by the Still Laboratory in producing color paper prints.

DATE 6-26-74 CONTROL # 1445 TASK _____ PREPARED BY _____

FILM 7271 EMULSION # _____ MFG _____ EXPIRATION DATE _____

EXPOSURE DATA		PROCESSING DATA		DENSITOMETRY	
SENSITOMETER	I-B	PROCESSOR	Hi-Speed	INSTRUMENT	MacBeth
ILLUMINANT	2850 °K	CHEMISTRY	ECP	TYPE	TD504
TIME	2 SEC.	SPEED ____ TANKS	4 FPM	APERTURE SIZE	3 MM
FILTER	2B	TEMP °F	75 TIME	FILTER	Status M
				SPEED ( )	
				D-MAX	
				GAMMA	
				BASE + FOG	

CHEMICAL ANALYSIS

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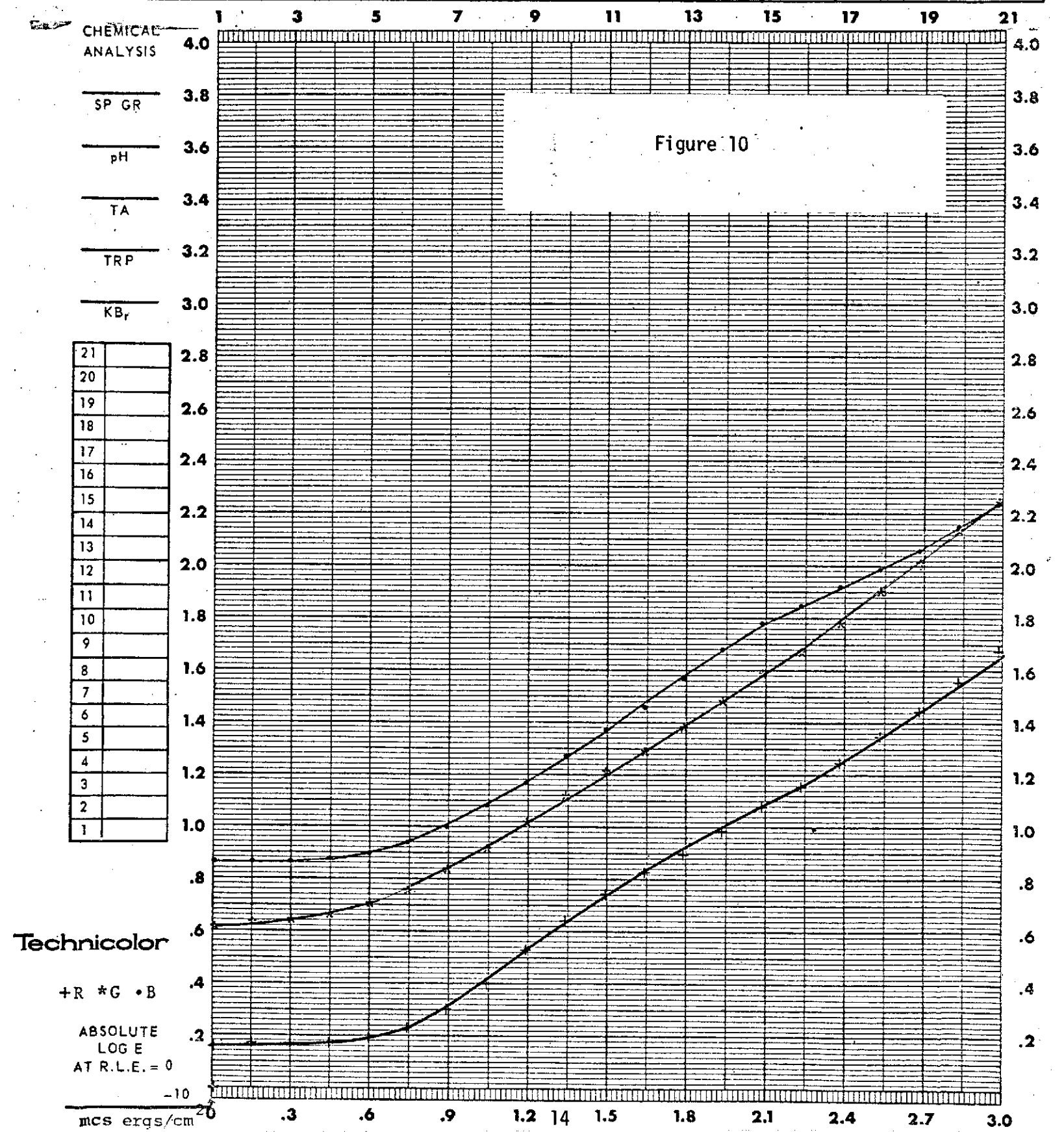
Figure 10



DATE 6-26-74 CONTROL # 1445 TASK _____ PREPARED BY _____

FILM 5271 EMULSION # _____ MFG _____ EXPIRATION DATE _____

EXPOSURE DATA		PROCESSING DATA		DENSITOMETRY	
SENSITOMETER I-B		PROCESSOR Hi-Speed		INSTRUMENT MacBeth	SPEED ( )
ILLUMINANT 2850 °K		CHEMISTRY ECP		TYPE TD504	D-MAX
TIME 2 SEC.		SPEED TANKS 4 FPM		APERTURE SIZE 3 MM	GAMMA
FILTER 2B		TEMP °F 75 TIME		FILTER Status M	BASE + FOG

CHEMICAL ANALYSIS

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Figure 11

Technicolor

+R *G •B

ABSOLUTE LOG E AT R.L.E. = 0

mcs ergs/cm²

SECTION IV

MACHINE MODIFICATIONS

The following modifications are required to use the ECP process in the 16/35/70 Hi-Speed Processor on a production basis. All tank numbers are those used in Figure 1 of this report.

1. The hypo clearing agent can be located in the ME-2A Fix tank (Tank #13). The bulk solution will be stored in the Chemical Mix area in what is now the Acid Rinse storage container. This container feeds into Tank #5, and will have to be diverted to feed into Tank #13.

2. The ME-2A 1st Acid Rinse tank (Tank #5) needs to be converted to a wash tank. This can be accomplished easily by plumbing Tanks 5 and 6 together. Since Tank 6 is now a wash tank, no additional water supply will be required to feed Tank 5.

3. The ME-2A Bleach tank (Tank #12) must be converted to a wash tank. This can be accomplished by plumbing Tanks 11 and 12 together; Tank 11 presently is a wash tank.

4. The Process Control Supervisor, is ascertaining the feasibility of using a common stabilizer for ECP and ME-4 process. If this is not possible, then the ECP stabilizer can be stored in the chemical mix area in what is now an unused Potassium Iodide storage container. This container, if required, will have to be plumbed to feed the Hi-Speed machine stabilizer tank (Tank #15).

5. Three new flowmeters will be required. The present flowmeters are inaccurate for the low replenishment rates required when processing the 35mm films.

6. The 16mm Rem-jet removal unit must be modified by lengthening the sponge area to prevent the possibility of scratching the film.

7. A splash pan should be built around the prebath unit to prevent water used when cleaning from contaminating the developer.

8. As presently configured, the ECP bleach is plumbed into the color developer drain, the ECP fix solution is plumbed into the "all other" drain, and the prebath solution drains into the sewer. Discussions with Fred Southard indicated that this would not be a problem from the standpoint of pollution control or silver recovery.

SECTION V

CONCLUSIONS AND RECOMMENDATIONS

- It is feasible to convert the 16/35/70 Hi-Speed Processor for use with the Kodak ECP process. The machine modifications recommended are reversible, thereby allowing the machine to be used for black-and-white or ME-2A chemistry in an emergency.

- Printer and process control is critical when preparing release prints from the internegative material due to the high gamma of the print stock. Careful monitoring will be required to produce repeatable results.

- The system gamma for the internegative and print films combined is approximately 1.70. The ECP system is therefore unsuitable for duplicating high contrast imagery. It is, however, ideally suited for duplicating ECO type low contrast original imagery.

- During the course of this study, the Motion Picture Laboratory has received internegatives for printing from laboratories outside the PTD and has been successful in producing excellent release prints. Therefore, the proposed reproduction of Kine color negatives should not present a problem, once a production ECP capability is established.